Lessons Learned from Developing Orange Flag Evaluation Data Analysis Tools

ITEA Test Instrumentation Workshop
May 2019

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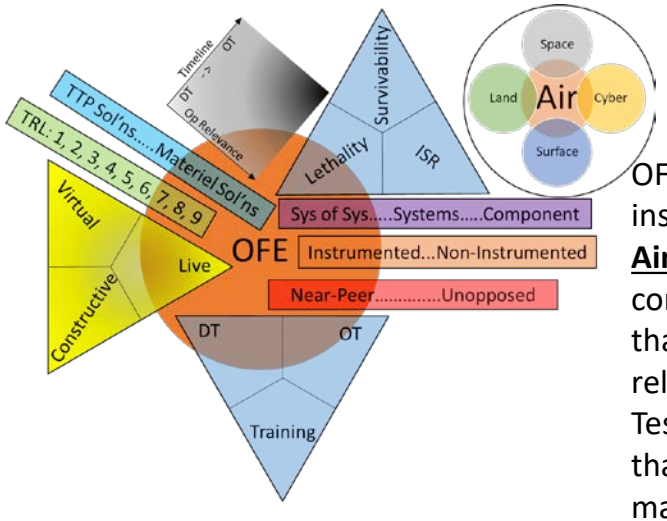
Lesson Learned Overview

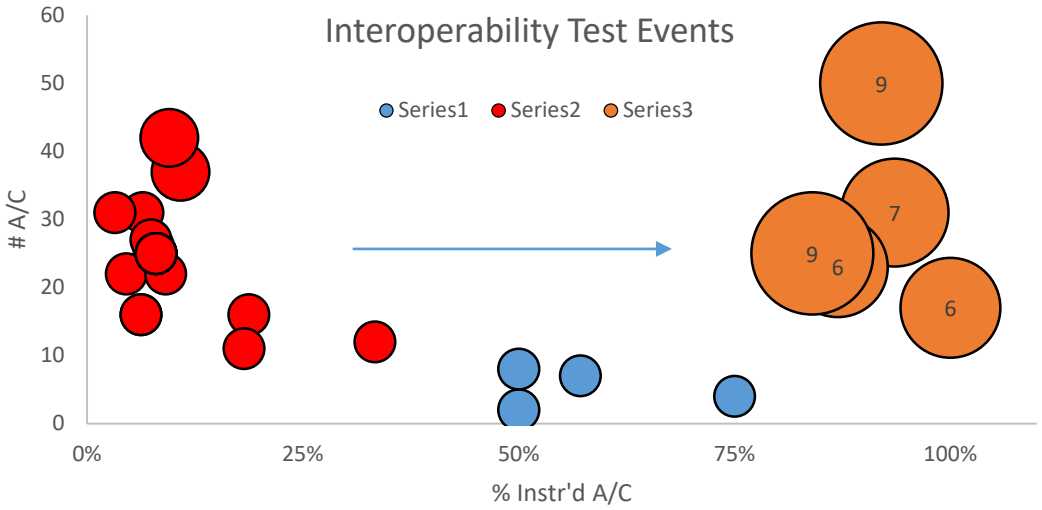
- Orange Flag Evaluation (OFE) Overview ← Context
- Next Steps (from ITEA 2018 Workshop) ← Background
- Multi-MDS Analysis Objective & Philosophy
- Foundational Data Analysis Tool (FDAT)
- Updated Challenges & Opportunities
  - Strategic
  - Tactical
  - Governance

} Lessons Learned Since May 2018

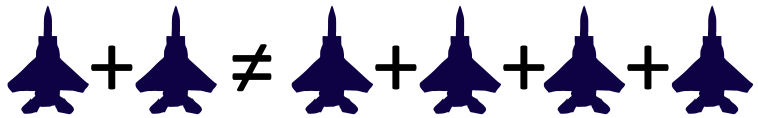
Orange Flag Evaluation (OFE) Overview

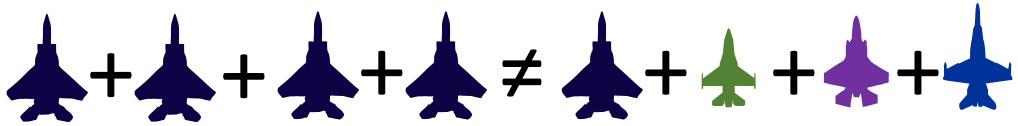


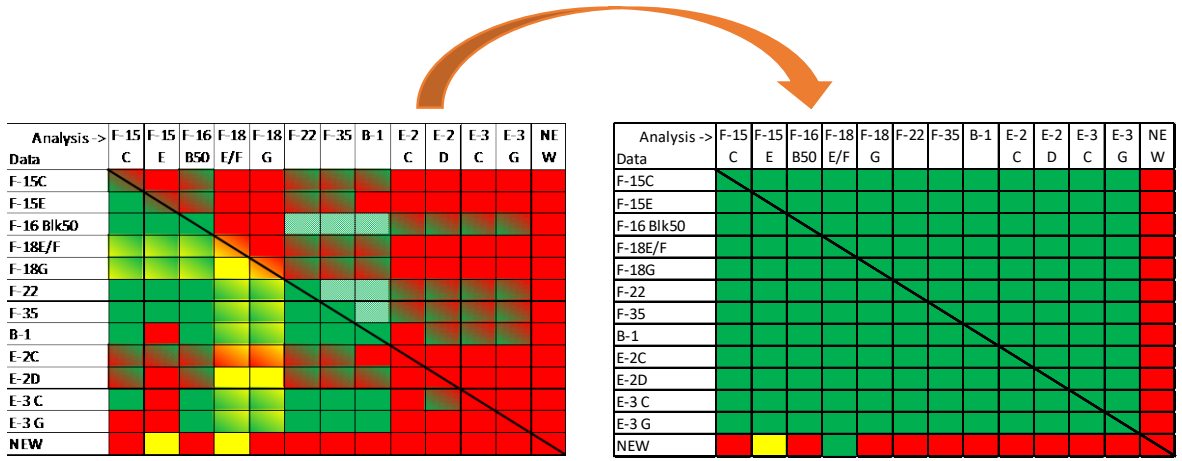
OFEs are multi-MDS, multi-domain, instrumented test events focused on **Air Domain Lethality** in near-peer conflicts. OFEs use real/live assets that are TRL 7+ in operationally relevant scenarios on Developmental Test timelines to generate data sets that can be analyzed to provide materiel solutions.



Loss of Decomposability







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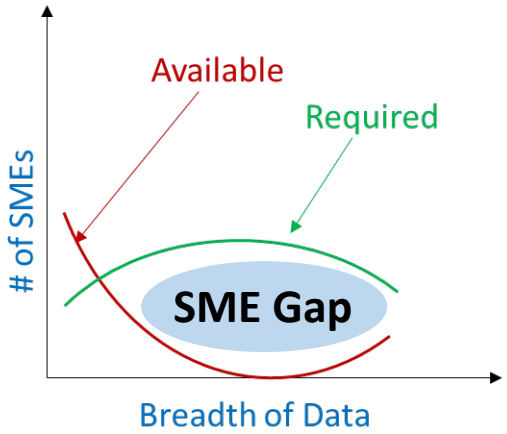
Next Steps (From 2018 ITEA Workshop)

- Challenges
  - Subject Matter Experts (SMEs) Gap
    - Can co-locate Multi-MDS LFEs data but lack the SMEs to analyze it
    - Data science (Big data/analytics/ML) SMEs lack T&E expertise
  - **Industrial Age** Governance for **Information Age** Challenge

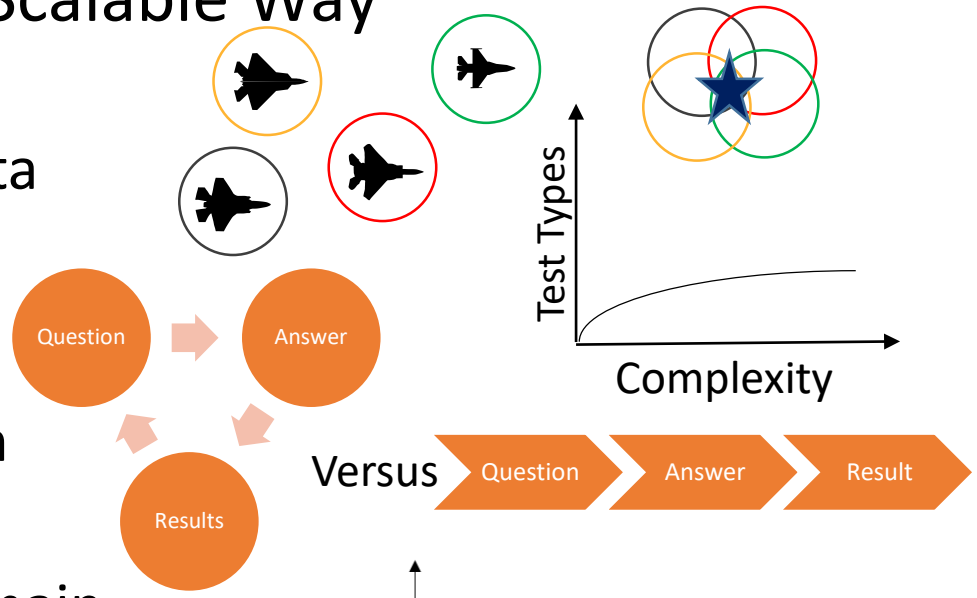
Industrial Age:	Info Control	Limit/Define	Rank	Compartmental
Information Age:	Info Exchange	Empower	Connections	Systematic

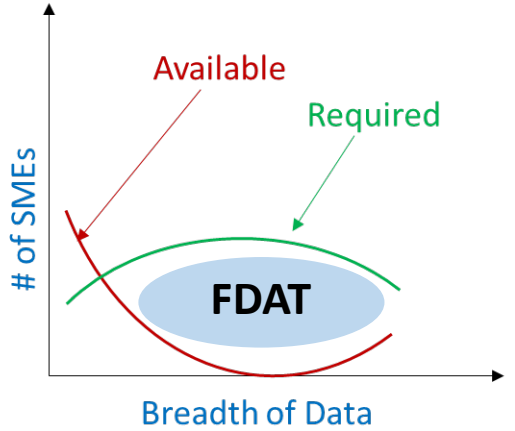


- Opportunities
  - The Software and Hardware Technologies Exists at the Commodity Level
    - Do not need to invent a quantum computer, Hadoop (or similar), or new language
  - Collaborative Workforce and an Empowering Senior Leadership
    - Millennials/Digital Natives are good at this & will soon be the majority of the workforce
    - Senior DoD leaders want to know how our systems work together -> Big data/analytics/ML

Multi-MDS Analysis Objective & Philosophy

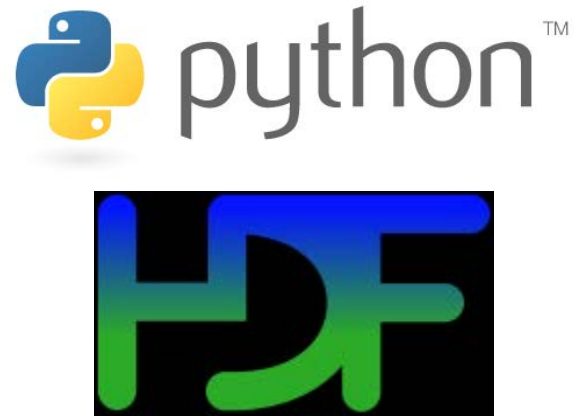
- Objective: Make the Data Accessible in a Scalable Way
  - **Accessible**: Physically and logically
  - **Scalable**: In complexity for self describing data
- Multi-MDS Data Analysis Philosophy
  - Answer "**Any**" question v. "**Many**" questions
  - **Analysis friendly** format v. data manipulation
  - Enable **generalists** v. specialist or lay-person
  - **Open source** and applicable to any MDS/Domain
- What Fundamental Problem Needs to be Solved?
  - Provide a **technology solution** to the '**SME gap**'





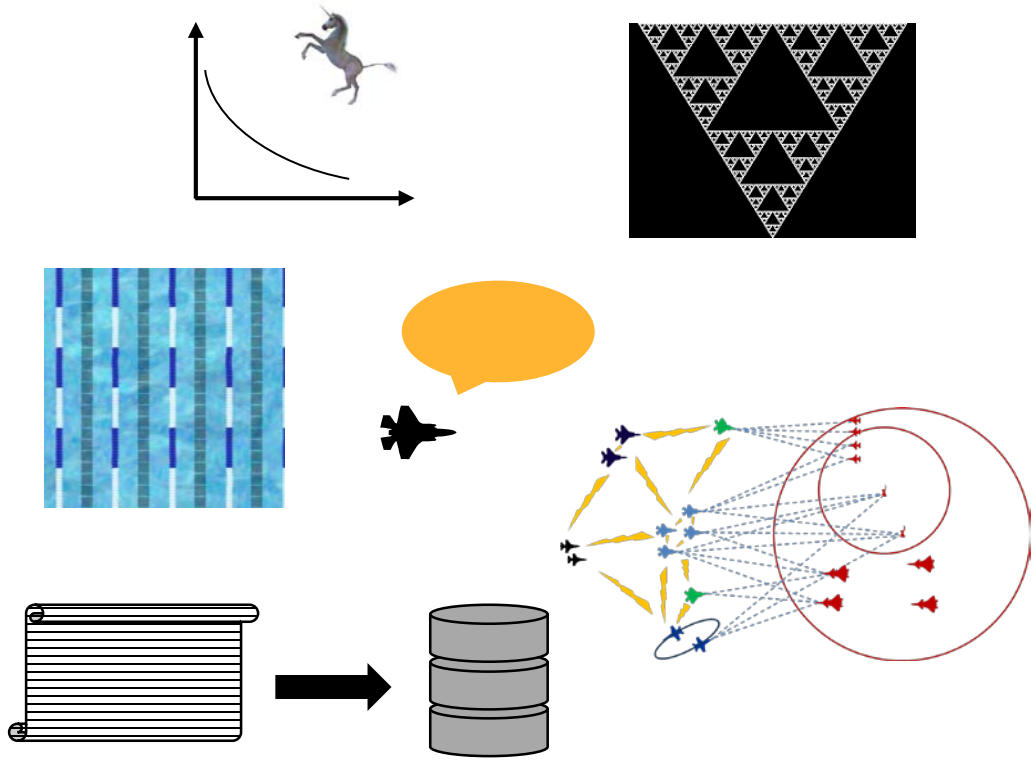
Foundational Data Analysis Tool (FDAT)

- Developed a **Python** Based Tool
  - Python is widely approved & essentially free
  - Open source, easy to learn, & powerful
- Stored Data in **HDF5** Format
  - Read-efficient, analysis friendly, & self-describing
  - Converted raw data to HDF5 files
- Machine Readable Logical Interfaces
  - Searchable **sqlite3** database
  - Linked database to HDF5 files
- **Model, View, Controller** Based



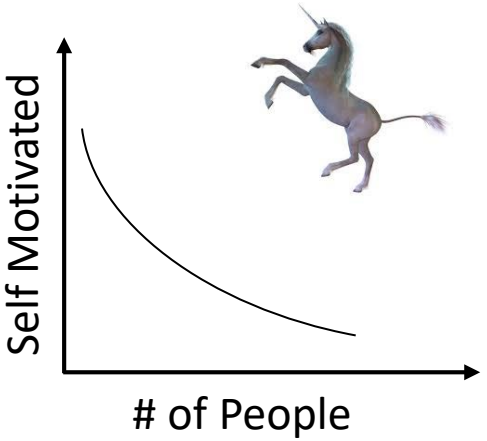
Updated Challenges & Opportunities

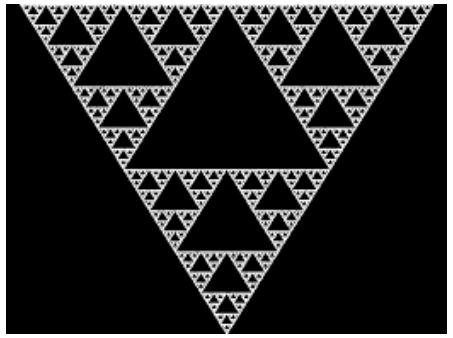
- Strategic
  - Approach – Go Big or Go Small?
- Tactical
  - Knowledge – Connecting SMEs
  - Information – Accessibility
  - Data Models – Mission Systems
- Governance
  - Ownership – Everyone = No One
  - Info Age – Learn from Others



Strategic – Approach (Go Big or Go Small?)

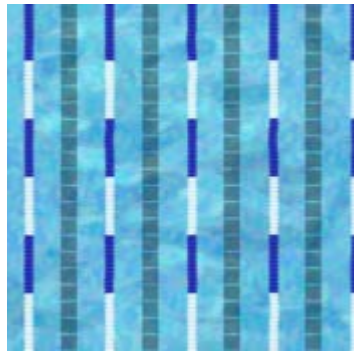
	Pros	Cons
Go Big:	• Data Sci. SME Driven • Enterprise Product • Guaranteed* Success	• Resource Intensive • Requirements Based • Momentum/Visibility
Go Small:	• Minimal Resources • Rapid Build/Learn Cycle • Scale with Knowledge	• Person Dependent • May Not Succeed • Not Enterprise Product





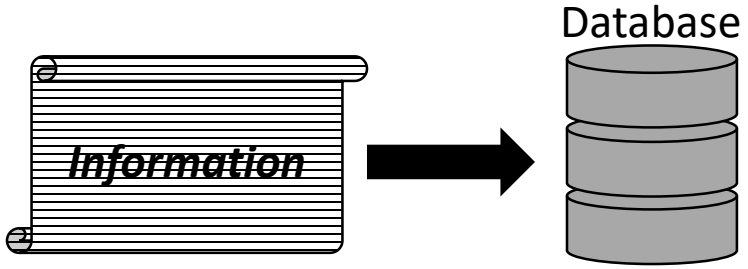
Tactical – Knowledge, Info, & Data Models

- Knowledge – Connecting SMEs
  - **Challenge**: SME's Staying in Their Swim Lanes
    - Data Scientists Know Data Science
    - Flight Testers Know Flight Test
  - **Opportunity**: Grow a Collaborative Workforce
    - Cross-Discipline Engineers are Invaluable & #'s Are Growing

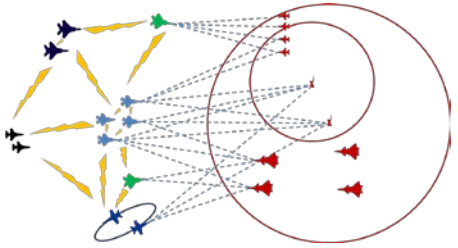


Versus

- Information – Accessibility
  - **Challenge**: Information is Costly to Access
    - Converting Information to Searchable / Machine Readable Data
  - **Opportunity**: Easily Accessible Information
    - Google/Facebook-like Multi-Domain Data Analysis Capability



- Data Models – Mission Systems
  - **Challenge**: No Multi-MDS/Domain Mission Systems Models
    - Advanced Data Analytics Tend to Require Mathematical Models
  - **Opportunity**: Predictive Machine Learning Tools
    - The Data Exist to Create Models of Integrated Mission Systems
    - Advanced Data Analytics Tools Can be Applied to Flight Test Data



Governance – Ownership & Information Age

- Ownership Across Organizational Lines
  - **Challenge**: Structured to Acquire Decomposable Systems
    - Air Domain Lethality now includes **non-decomposable** systems
    - From an organizational perspective **Everyone** leads to **No One**
  - **Opportunity**: A Collaborative Workforce Will Cross Organizational Boundaries
    - Empower the collaborative, organization-agnostic workforce (**Millennials**)
- Information Age v Industrial Age Governance
  - **Challenge**: Industrial Age Governance for Information Age Problems
    - Structure, control, & decomposable **assumptions** do not apply to complex systems
  - **Opportunity**: The Engineering Workforce Can Solve Information Age Problems
    - **Technology** is mature, but needs to be **applied** to flight test – **definition of engineering**!
    - Alternative organizational **examples** of what to do (or not do) already exist

Questions / Discussion

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	**2. REPORT TYPE**	**3. DATES COVERED** *(From - To)*
07/05/2019	Briefing slides	14-16 May 2019 (published afterwards).

4. TITLE AND SUBTITLE
Lessons Learned from Developing Orange Flag Evaluation Data Analysis Tools

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)
Christopher Klug

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) AND ADDRESS(ES)
412th Test Wing
195 E Popson Ave
Edwards AFB CA 93524

8. PERFORMING ORGANIZATION REPORT NUMBER
412TW-PA-19253

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)
412th Test Wing
195 E Popson Ave
Edwards AFB CA 93524

10. SPONSOR/MONITOR'S ACRONYM(S)
N/A

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for public release A: distribution is unlimited.

13. SUPPLEMENTARY NOTES
International Test and Evaluation Association (ITEA) Test Instrumentation Workshop (TIW) / Las Vegas, NV / 14-16 May 2019

14. ABSTRACT
In order to leverage the tremendous value of multi-platform data, the data need to be reasonably accessible to many analysts. The development of the Foundational Data Analysis Tool (FDAT), to support Orange Flag Evaluations, focuses on making the data accessible – both physically and logically – in a scalable manner. This presentation will discuss the challenges and opportunities experienced while developing FDAT for large, increasingly complex data sets.

15. SUBJECT TERMS
OFE(Orange Flag Evaluations), Decomposability, Interoperability, DT(Developmental Test), OT(Operational Test), Governance, Information Age, FDAT (Foundational Data Analysis Tool)

16. SECURITY CLASSIFICATION OF:			**17. LIMITATION OF ABSTRACT**	**18. NUMBER OF PAGES**	**19a. NAME OF RESPONSIBLE PERSON**
					412 TENG/EN (Tech Pubs)
a. REPORT	**b. ABSTRACT**	**c. THIS PAGE**	None	12	**19b. TELEPHONE NUMBER** *(include area code)*
Unclassified	Unclassified	Unclassified			661-277-8615